

Public Review Comment Matrix

Originating Office: AIR-6B0	Document Description: TSO-C211 TSO for Detect and Avoid (DAA) Systems	Project Lead/Reviewer Sheila Mariano	Reviewing Office: AIR-6B0	Date of Review: 9/8/2017
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	Commenter	Section # and Page #	Comment	Suggested Change and Rationale	Disposition
1.	Ted Lester	3 (pg 1-2)	How is a system treated that can do both Class 1 or Class 2 functionality based on an installation setting? Especially applicable to articles B-E, although I guess it could apply to article A.	Add note about how articles can be certified as both Class 1 and 2 equipment if meet the requirements of both and have a means of configuring between the two.	Agree. Added a note to Table 1 to allow both Class 1 and 2 equipment designations for any article and added information in the installations 5.a.(3) installation procedures and limitations item 4), accordingly.
2.	Ted Lester	3.a (pg 3)	“maintain DAA Well-Clear” only covers part of the function. Remain not maintain is preferred term internationally and in DAA MOPS to cover the entire system’s function. Also, there is no hyphen between Well Clear. A hyphen would only be appropriate if it is used as a compound adjective (which it is not).	Change to “remain DAA Well Clear”. Also search and replace all “Well-Clear” with “Well Clear”	Agree. Change accepted and is reflected in the TSO document.
3.	Ted Lester	3.h (pg 5)	It is unclear what “target source associated with the encounter” is referring to.	Change to “source(s) of the information associated with an intruder (e.g. radar, ADS-B, and/or active surveillance)”	Agree. Change accepted and is reflected in the TSO document.
4.	Ted Lester	5.a.3 (pg 6)	Missing information on how alerting and guidance suppression is implemented, which will be unique system to system.	Add something to the install information list (and possibly operator manual) about how the automatic inhibition mechanism in 2.2.4.1 operates and is configured.	Disagree. No Change. Automatic inhibition is very specific and can be addressed in the DAA installation Advisory Circular, which will follow the publication of this TSO.

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5.	Garmin	3.b.(1) through 3.b.(2)(b)	<p>Paragraph 3.b. includes the statement:</p> <p style="padding-left: 40px;">b. Failure Condition Classifications.</p> <p style="padding-left: 40px;">(1) Loss of the function defined in paragraph 3.a is a major failure condition.</p> <p style="padding-left: 40px;">(2) Failure of the function that causes misleading information is as follows:</p> <p style="padding-left: 40px;">(a) For Class 1 and Class 2 - Major failure condition for malfunctions causing misleading DAA alerting and/or guidance.</p> <p style="padding-left: 40px;">(b) For Class 2 Only - Hazardous/severe-major failure condition for malfunctions causing misleading TCAS II RA.</p> <p style="padding-left: 40px;">Note: Advisory Circular (AC) 20-151C, Airworthiness Approval of TCAS II, Versions 7.0 & 7.1 and Associated Mode S Transponders, or later version, provides further guidance for the failure classification of TCAS II systems. RA failure conditions defined in AC 20-151C include missing RA, incorrect RA, and false RA.</p>		<p>Disagree. No Change. The intent of the hazardous classification for misleading information is for the incorrect RA. The DAA system does not utilize TSO-C119 due to the replacement of the Traffic Alerting (TA) modes with DWC alerting. Therefore, this TSO needs to address the failure classifications of Class 2 DAA systems with TCAS II 7.1 RA functionality. AC 20-151C addresses the RA functionality well and there is no need to duplicate that effort. The AC will be published prior to the TSO release.</p>
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			<p>This wording is redundant, inconsistent, and confusing.</p> <p>This text is redundant as it defines a failure condition classification that is already covered by TSO-C119c.</p> <p>The wording is inconsistent and confusing as it references AC 20-151C (which is yet to be published) for additional guidance for failure classifications; however, AC 20-151C section 2.3.8 “Failure Conditions System Safety Assessment and Design Assurance” does not identify an actual failure condition classification. AC 20-151C Section 2.3.8. does identify qualitative and quantitative probability objectives, some of which correspond to a failure condition classification of Hazardous per Figure 2 of AC 23.1309-1E for Part 23 Class IV aircraft. The probability objectives identified in draft AC 20-151C 2.3.8.4 were, however, significantly increased from the previous AC 20-151B Section 2-20 without any justification, and have been requested to be reverted to the previous probabilities in Garmin comments to draft AC 20-151C.</p>		
6.	Garmin	3.b.(3) Page 2	Paragraph. 3.b.(3) includes the statement:		Disagree. No Change. The TSO provides the minimum level of

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			<p>Design the system to at least the above failure condition classifications.</p> <p>Wording needs to change to allow failure condition to be determined at the aircraft level.</p> <p>This statement implies the failure condition classification of an appliance is determined by the TSO regardless of mitigations employed to meet aircraft level safety requirements such as redundant appliances/systems. Unless the DAL cannot be affected by the installation, the aircraft System Safety Assessment should determine the failure classification and by extension, the design assurance level (DAL) requirement. The AFHA/SFHA/PASA/PSSA ultimately determines the DAL requirement for a particular installation. Specifying the DAL at the appliance level without the benefit of the specific AFHA/SFHA/PASA/PSSA means that in some cases the DAL will undoubtedly be higher and more costly than necessary. This will have a chilling effect on the installation of new, safety enhancing technologies since the cost will be greater than necessary. It is possible to build and certify a TSOA appliance that cannot be approved for installation in one or more aircraft</p>		<p>design assurance levels accepted by the FAA. This alleviates the applicant burden of determining the level of safety needed for use of the system on a typical UAS installation. The FAA conducted a Safety Review Management Panel to verify the DAA failure classification level and the results provides assurance that the failure level referenced in this TSO is appropriate to ensure adequate level of safety needed for introduction in to the NAS. The TSO does not guarantee installation approval. The TC or STC applicant will need to assure the design assurance level is commensurate with the aircraft type design. However, if a lower level of design assurance is requested at the TSO level, then the applicant is free to request a deviation approval to the TSO.</p>

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			types because it does not have the required DAL. Similarly, just because the appliance meets a TSO DAL does not mean it can be approved for installation. We recommend that no failure classification/DAL requirement be included in a TSO when the installation can affect or mitigate the hazard level and therefore consideration should be given to revising paragraph 3.c in this TSO to the general guidance in the Recommendation column.		
7.	Garmin	3.e Page 4	The paragraph references “AC 20-115C, <i>Airborne Software Assurance</i> , dated July 19, 2013”. AC 20-115C will soon be replaced by AC 20-115D.		Agree. Revised to read “AC 20-115C or latest revision.” This change will also be incorporated into the TSO template in appendix G of Order 8150.1D. We did not include AC 20-115D because this TSO is slated to publish before AC 20-115D.
8.	Garmin	3.f Page 4	The paragraph includes the text “custom electronic hardware” which is inconsistent with the TSO Template in Order 8150.1D Appendix G. which uses “custom airborne electronic hardware.”		Partially Agree. In this particular context, removing airborne in the sentence is appropriate, since there is a GCS. We coordinated with commenters and they agreed. Commenters withdrew comment. In addition, received concurrence from TSO template policy holder to modify text to

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					accommodate the application of the GCS. No Change.
9.	Garmin	3.f Page 4	<p>Including this specific DO-254 reference is redundant to the rest of the paragraph in this section.</p> <p>For custom electronic hardware determined to be simple, RTCA/DO-254, paragraph 1.6 applies.</p> <p>DO-254 makes it clear how to address “simple” custom airborne electronic hardware.</p>		Disagree. Spoke directly with the commenters and they withdraw the comment. The intent of referencing DO-254 section 1.6 for simple custom devices in the template is to complement the previous template sentence which only addresses complex custom devices. The inclusion of section 1.6 ensures that the verification and configuration management processes required by DO-254 for simple devices are performed and the resulting data artifacts for these processes are created.
10.	Garmin	4.a. Page 5	<p>The paragraph includes the following text.</p> <p>Mark at least one major component permanently and legibly with all the information in 14 CFR § 45.15(b), and include equipment class and article designator.</p>		Partially agree. The FAA has determined that using the installation instructions or software is an acceptable method for defining the article and will add this allowance to the sentence for classes and article designations.

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			Including the equipment class is sometimes problematic when the functionality can be defined by software.		
11.	Garmin	5.a.(3) Page 6	<p>The paragraph states to include the following statement:</p> <p style="padding-left: 40px;">This article meets the minimum performance and quality control standards required by a technical standard order (TSO). Installation of this article requires separate approval.</p> <p>This text does not align with the text identified in the TSO Template in Order 8150.1D Appendix G.</p>		Agree. Revised according to the latest template in FAA Order 8150.1D.
12.	Garmin	5.f Page 7	<p>Paragraph. 5.f includes the statement:</p> <p style="padding-left: 40px;">Identify functionality or performance contained in the article not evaluated under paragraph 3 of this TSO (that is, non-TSO functions). Non-TSO functions are accepted in parallel with the TSO authorization. For those non-TSO functions to be accepted, you must declare these functions and include the following information with your TSO application:</p>		Agree. Coordinated with the TSO template policy program manager. Removed “or performance” as suggested. The words “or performance” will be removed from the TSO template in appendix G of Order 8150.1D during the next revision.

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			The GAMA 16-28 “Industry Recommendations on the Management of Non-Technical Standard Order Functions” Recommendation 2 recommended revising the Appendix G TSO template to remove “or performance” from the quoted paragraph 5.f statement to ensure non-TSO function definitions are “fully aligned with the original intended N8150.3 definition”. This recommendation was not followed when FAA Order 8150.1D was published.		
13.	Garmin	5.f.(5) and 5.f.(6) Page 7	<p>These sections state the following:</p> <p>(5) Test plans, analysis and results, as appropriate, to verify that performance of the hosting TSO article is not affected by the non-TSO function(s).</p> <p>(6) Test plans, analysis and results, as appropriate, to verify the function and performance of the non-TSO function(s) as described in paragraph 5.f.(1).</p> <p>The bolded text “and results” is not included in the TSO Template in Order 8150.1D Appendix G.</p>		Agree. Revised according to the latest template in FAA Order 8150.1D. TSO Policy holder clarified to us that non-TSO functions are not validated and are only checked on a non-interference basis to the TSO functions for TSO approval.
14.	Garmin	5.g. Page 7	This paragraph does not align with the TSO Template in Order 8150.1D Appendix G.		Agree. Change accepted.

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			Additionally, section 5.h. in the TSO Template in Order 8150.1D Appendix G is not included in this TSO draft.		
15.	Garmin	6.h. Page 8	“DO-254, Appendix A, Table A-1” should be “DO-254, Appendix A, Table A-1” (a letter l (L) is used instead of the number 1 (one)).		Agree. They look the same. l was replaced with 1. Coordinated with TSO policy manager and it will be changed.
16.	Garmin	7. Page 8	<p>This paragraph does not include the following text in Section 7.c. in the TSO Template in Order 8150.1D Appendix G:</p> <p style="text-align: center;">c. If the article contains software, include one copy of the OPR summary.</p> <p>This is good because per Order 8150.1D Appendix G paragraph 7, the OPR summary is considered “furnished data” required to be provided to any “entity (such as an operator or repair station)” that is furnished “articles manufactured under this TSO”. Operators and repair stations typically do not have the same capability as a TC/STC design approval holder to make an appropriate assessment of OPR effect. Consequently, it will only serve to cause confusion to require an OPR summary to be provided to operators and repair stations.</p>		<p>Partially Agree. Paragraph 7.c was modified as follows:</p> <p style="padding-left: 40px;">c. If the article contains software, provide one copy of the Open Problem Report (OPR) summary to type certification, supplemental type certification, or amended type certification design approval holders or applicants seeking installation approval of the TSO.</p>

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			This same concern has been raised in the context of the FAA/EASA/Industry A(M)C 20-OPR discussions.		
17.	Boeing	2, Table 1, Page 2	The proposed text in Table 1 currently states: For Class 1, DAA Equipment Article Designation = B, Function states Track Processing and DAA Alerting ² For Class 1, DAA Equipment Article Designation = C, Function states DAA Guidance ²	We recommend revising the text in Table 1 as follows: For Class 1, DAA Equipment Article Designation = B, Function should state Track Processing and DAA Alerting <i>and Guidance</i> ² For Class 1, DAA Equipment Article Designation = B, Function should state DAA <i>Alerting and</i> Guidance ² Table 1, Note 2 states: “Articles B and C contain DAA alerting and guidance functions that are interchangeable on an	Agree. Change accepted and is reflected in the TSO document.

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			<p style="text-align: center;">Table 1 – DAA Classes and As</p> <table><tr><th rowspan="2">Class</th><th rowspan="2">Equipment¹</th><th colspan="2">Criticality</th><th rowspan="2">DAA Article Designation^{2&3}</th></tr><tr><th>Loss of Function</th><th>Misleading Information</th></tr><tr><td rowspan="5">1</td><td rowspan="5">DAA – Basic</td><td rowspan="5">Major</td><td rowspan="5">Major</td><td>A</td></tr><tr><td>B</td></tr><tr><td>C</td></tr><tr><td>D</td></tr><tr><td>E</td></tr></table>	Class	Equipment ¹	Criticality		DAA Article Designation ^{2&3}	Loss of Function	Misleading Information	1	DAA – Basic	Major	Major	A	B	C	D	E	<p><i>unmanned aircraft system platform. They may reside either in the UA or in the CS”.</i></p> <p>Revising the text in Table 1 will comply with Note 2 that states that either the Unmanned Aircraft (UA) or the Control Station (CS) can contain the DAA alerting and guidance functions.</p>	
Class	Equipment ¹	Criticality				DAA Article Designation ^{2&3}															
		Loss of Function	Misleading Information																		
1	DAA – Basic	Major	Major	A																	
				B																	
				C																	
				D																	
				E																	
18.	Sean Calhoun, sean.calhoun@calanalytic s.com	All	The current DO-365 has a lot of uncertainty associated with it and lacks operational validation of those requirements. The FAA sponsored Safety Risk Management Document (SRMD) process undertaken to perform some level of	Suggest language as part of the TSO, if it doesn’t already exist, that limits its scope to the physical and EMI aspects of the unmanned aircraft and	Disagree. The TSO is not an operational approval, although the work conducted by RTCA SC-228 developed the MPS considering operational																

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			validation from a safety and some aspects of operational acceptability perspectives has many unresolved, inconsistent and unsubstantiated data elements contained within it. It is unlikely that these issues would affect the structural and electronic integrity of the airframe, large questions remain in terms of the safety and acceptability in terms of airspace integration within the NAS.	not the overall impact to integration into the NAS. That further limited deployment, monitoring, and other such safeguards and analysis are required before DO-365 and this subsequent TSO are ready for full NAS deployment.	suitability in certain airspace. There is a note that specifies the intended operation and airspace use of the equipment. The TSO applicant will identify limitations of the system, which may limit the operation of the system in certain airspace, as specified in MPS. When the STC or TC applicant installs the TSO on their aircraft, they will also verify the operational limitations of the system or will change the operational limitation in the flight manual to accommodate what has been tested and verified for TC/STC approval.
19.	EASA, Runge Friedhelm	General	<p>a) The DO-365 standard was developed considering a limited scope of operations in certain classes of airspace. This is not reflected in section 3 (a) of the TSO, and we propose to clearly record that limited scope in the TSO.</p> <p>b) The TSO also does not reflect the notion that the DAA system only provides a 'Remain Well Clear' (RWC) function,</p>		<p>a) Agree: A note has been added to address this issue. "This MPS has been validated for equipment intended to support operations climbing and descending through U.S. Class D, E, and G airspace, enroute to and from Class A airspace, and to</p>

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			<p>whereas in the ICAO and JARUS definitions, a DAA system provides both RWC and Collision Avoidance (CA) functionality.</p> <p>c) The combination of Class 2 DAA systems with an ACAS II (v. 7.1) is raising human factors concerns, as the pilot may potentially be confronted with multiple alerts, originating from both the DAA system for the ‘Remain Well Clear’ (RWC) function that it provides and others that the ACAS II system issues for the TA and RA. There does not appear to be much prioritisation between those alerts, which implies that they could multiple subsequent cautions and warnings. (RWC: Warning, TA: Caution, RA: Warning). It is unclear to me how this design would meet our human factors criteria.</p> <p>d) The indicated criticality of the DAA function is not commensurate with the criteria established in JARUS, with regards to the provisioning of misleading information.</p>		<p>and from Special Use Airspace. We have not evaluated the operational suitability of the equipment for extended operations in Class D, E, and G airspace or for transit through Class A, B, and C airspace. Although we are unaware of any safety issues related to its operation in that airspace, changes to equipment operation may be required to maintain air traffic efficiency.”</p> <p>b) Agree, but the FAA maintains that there is no FAA regulation that mandates CA for aircraft under 33,000 lbs; therefore, it should not be mandated exclusively for UAS. The FAA maintains that a DAA system is a means to provide a DAA well-clear to the UAS Pilot in Command.</p> <p>c) Human Factor issues were analyzed for Class 2 DAA</p>

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					<p>systems during MOPS development. The prioritizations were addressed in the MOPS and the TCAS II v7.1 was modified for the DAA implementation to ensure interoperability with coordination with other TCAS II systems.</p> <p>d) DAA alerting and warning systems failure criticality is based on .1309 analyses, using engineering judgment, understanding the exposure and probability of the failure that may cause misleading information. The DAA functionality Class 1 does not provide hazardous level misleading information to the pilot. Misleading information for essential level warning level systems used for operation to a pilot has historically been considered major for part 25 and 23 aircraft, such TAWS,</p>

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